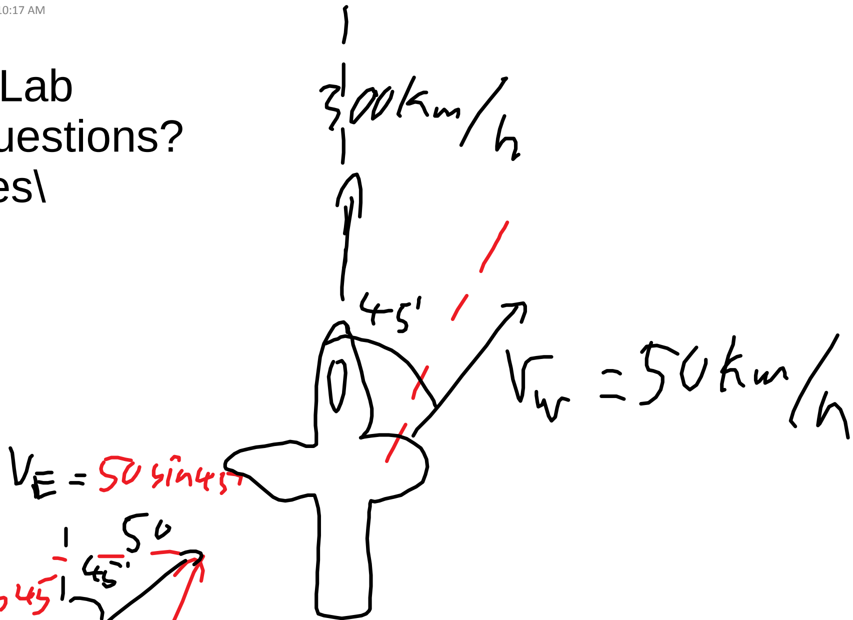
Thursday, October 06, 2016 10:17 AM

Hand in Lab
vector questions?
projectiles\

p62-63
Q23 b)





$V_r^2 = 300^2 + 50^2 - 2(300)(50)\cos 135°$

$V_r = 337 km/h$

b) $V_{East} = 50 \sin 45°$
$= 35.355 km/h$

$d = Vt = 35.355 km/h (0.50 h)$
$= 17.7 km = 18 km$

Projectiles -
An object moving through space under the influence of gravity without propulsion.
bird is not a projectile
dead bird is a projectile

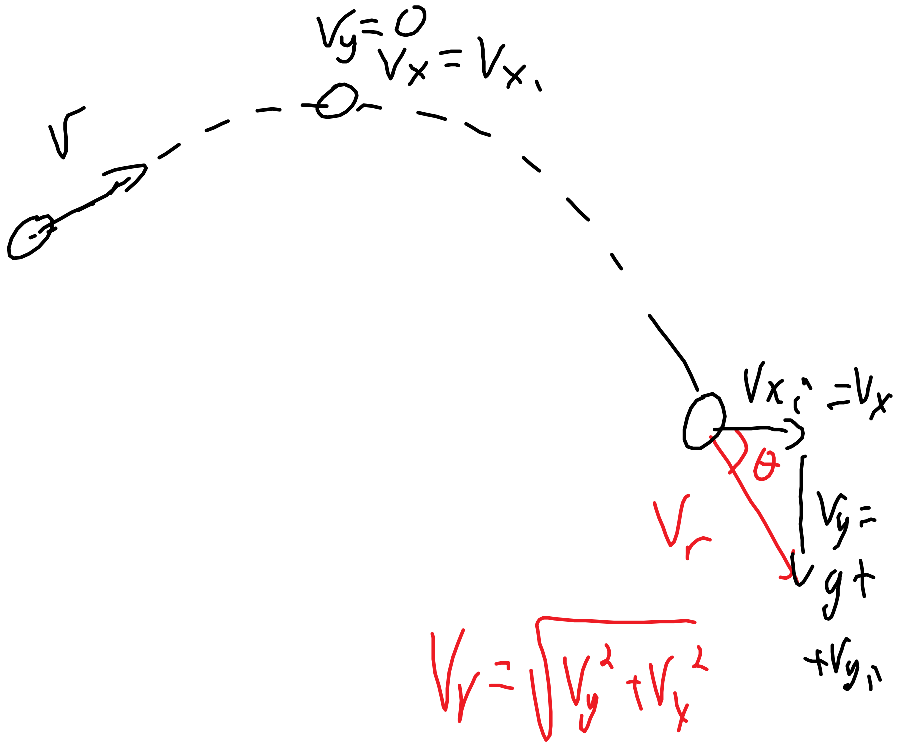
assumption - assume that air resistance is negligible for our projectiles. (too small to

matter)

Big Idea:
A horizontally launched projectile falls at the same acceleration as a dropped projectile in the absence of air resistance.
$a=g=9.80 m/s^2$ near Earth

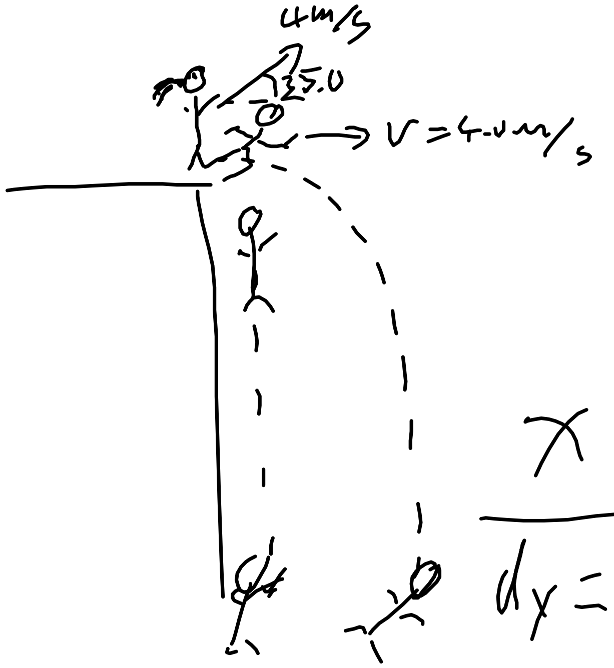
the horizontal component of motion for a projectile will be constant velocity.

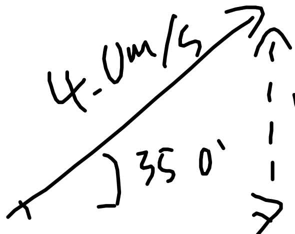
separate the motion into horizontal, x, and vertical, y, components of motion.




1. 3 friends go cliffjumping. Friend 1, Brandon, drops straight down with zero initial velocity. Friend 2, Raoul, runs horizontally at 4.0 m/s off the cliff. Friend 3, Shirley, runs at 4.0 m/s and jumps up at 35.0 degrees above the horizontal. If the cliff is 10.0 m high,

a) how long are each friend in the air?
b) where do they land?
c) what is their velocity just before hitting the water? (magnitude and direction)




$V_{y_i} = 4.0\,m/s \sin 35°$

$V_{x_i} = 4.0\,m/s \cos 35°$

| x | y |
|---|---|
| $d_x = V_x t$ | $d_y = \frac{1}{2} g t^2 + V_{y_i} t$ |
| | $V_{y_f} = V_{y_i} + g t$ |

Brandon $V_x = 0$ $V_{y_i} = 0$

$a = g = 9.80\,m/s^2$

$d_y = 10.0\,m$

a) $t = ?$; $d = \frac{1}{2} g t^2 + V_{y_i} t$ ($V_{y_i} t \to 0$)

$$t = \sqrt{\frac{2d}{g}} = \sqrt{\frac{2(10m)}{9.8\,m/s^2}}$$

$t = 1.43\,s$ = ~~1.4 s~~

b) at the bas of cliff

c) $V_y = gt + V_i = 9.8(1.43)$

$$V_y^2 = V_{y_i}^2 + 2ad \quad +0$$

$$V_{yf} = 14\ m/s \text{ down}$$

Raoul

a) Same as Brandon

$t = 1.43\ s$

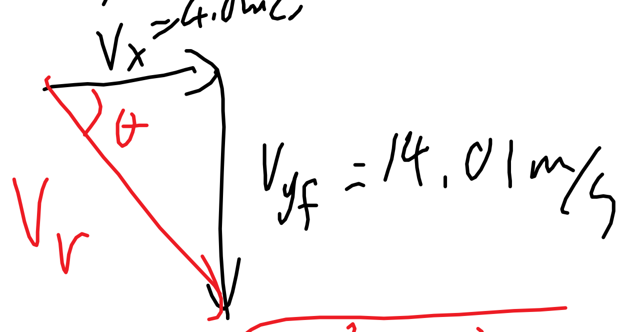
x - y are independent

b) $d_x = V_x t = (4.0\ m/s)(1.43\ s)$

$= 5.7\ m$ ← from base of clif

c) $V_{yf}$ = Same as Brandon

but $V_x = 4.0\ m/s$

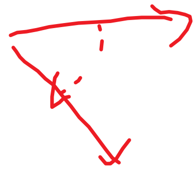



$$V_r = \sqrt{V_{yf}^2 + V_x^2}$$

$$V_r = \sqrt{14.01^2 + 4^2}$$

$V_r = 14.6\,m/s$

$\theta = \tan^{-1}\frac{14}{4} = 74^\circ$ below horizontal



Shirley

a) $V_{y_i} = 4.0\,m/s \sin 35.0^\circ$

$= (+)2.2943\,m/s$

$V_x = 4.0\,m/s \cos 35.0^\circ$

$= 3.277\,m/s$

$a = g = -9.80\,m/s^2$

$d_y = -10.0\,m$

a) $d_y = \frac{1}{2} g t^2 + V_{y_i} t$

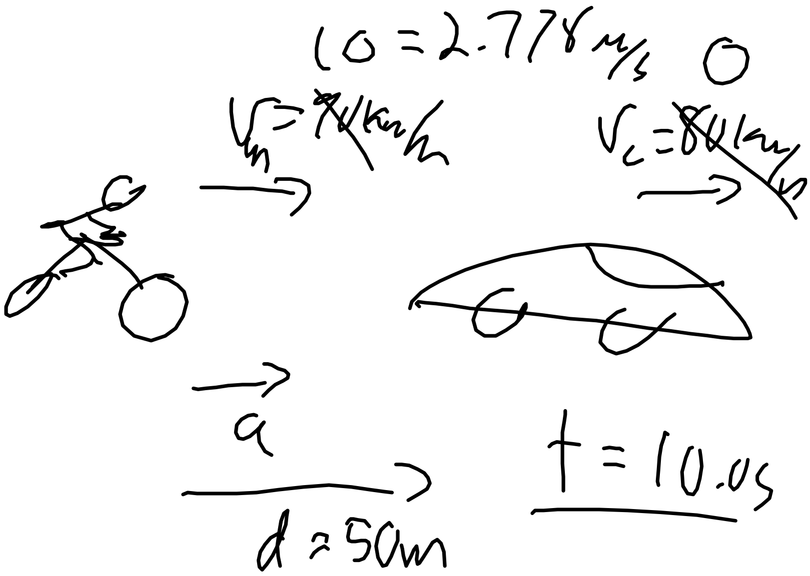
$-10.0\,m = \frac{1}{2}(-9.8)t^2 + 2.294t$

$0 = -4.9t^2 + 2.294t + 10$

$$t = \frac{-2.294 \pm \sqrt{2.294^2 - 4(-4.9)(10)}}{2(-4.9)}$$

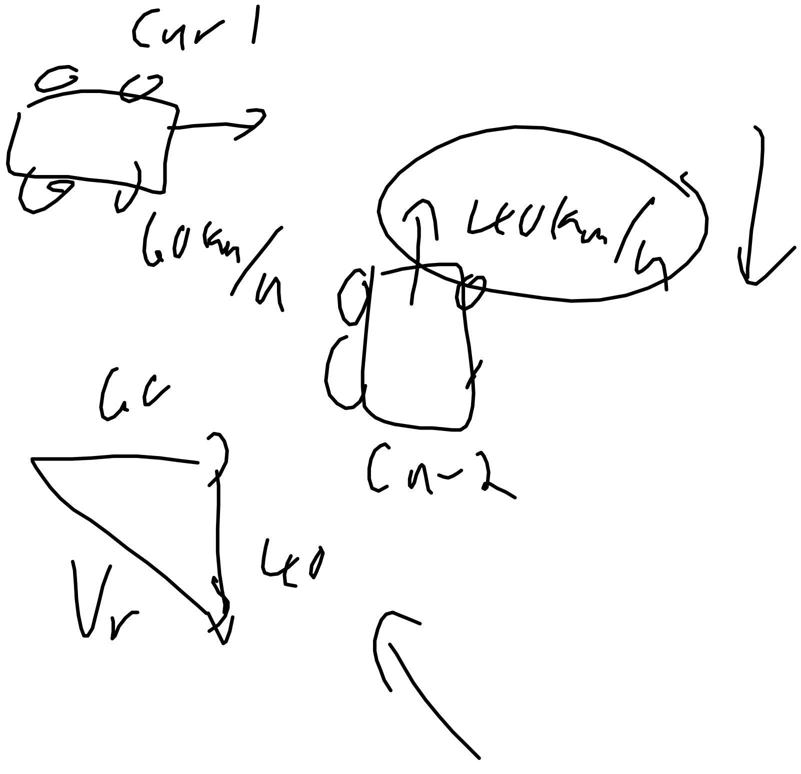
P62

Q31




$$d = \frac{1}{2}at^2 + v_i t$$

Q29




Projectiles
Sunny: "You throw something at someone, that's a projectile."
An object moving through space under the influence of gravity without propulsion.

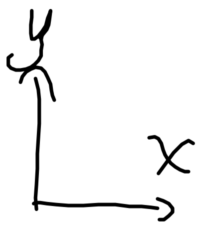
A flying bird is not a projectile - dead bird is a projectile.

Assumptions: Air resistance is negligible.  (too small to matter)
look at video
https://www.youtube.com/watch?v=5C5_dOEyAfk

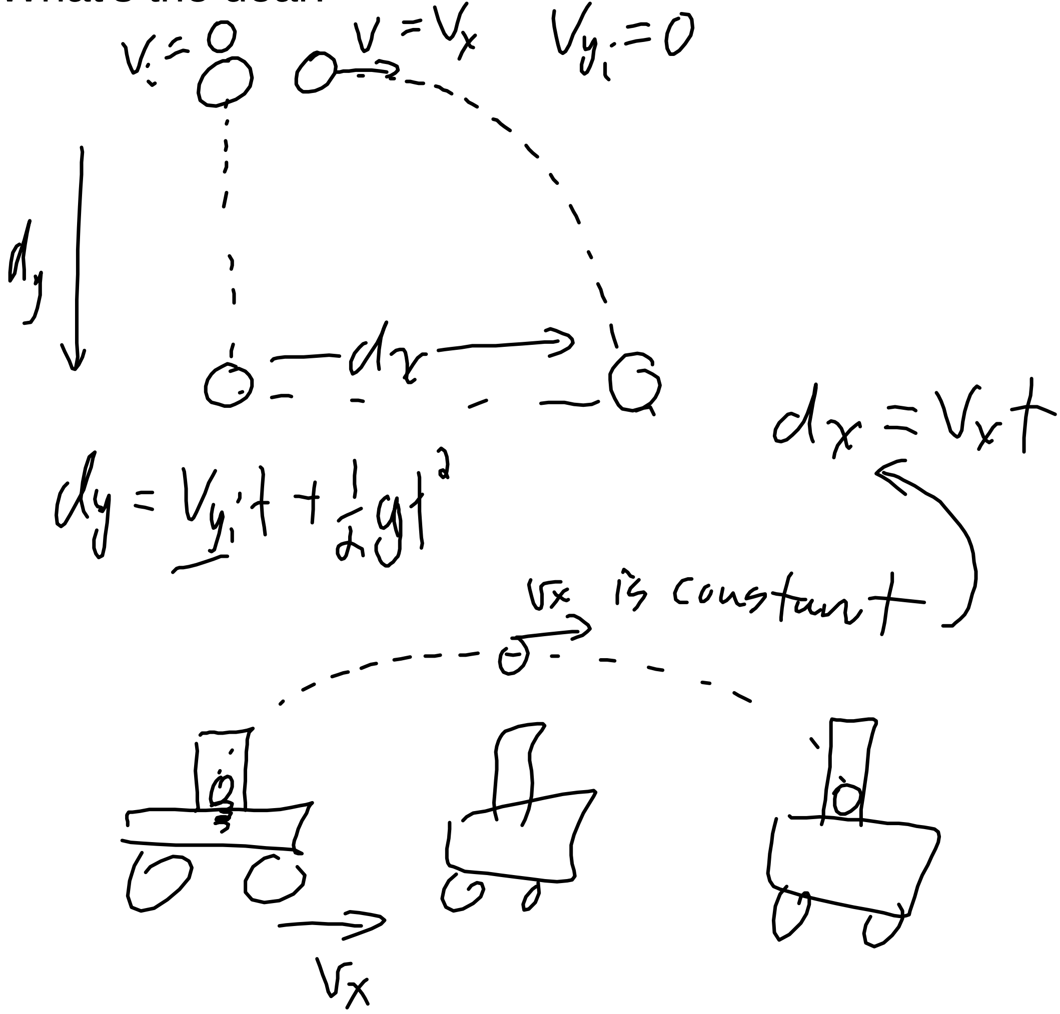
objects fall at 9.80m/s$^2$ near Earth if air resistance is neglected.

When I throw a pen sideways at the same time as I drop another pen, they both hit the ground at the same time.

Mythbusters:
https://www.youtube.com/watch?v=abUBrQmI33Q




What's the deal?

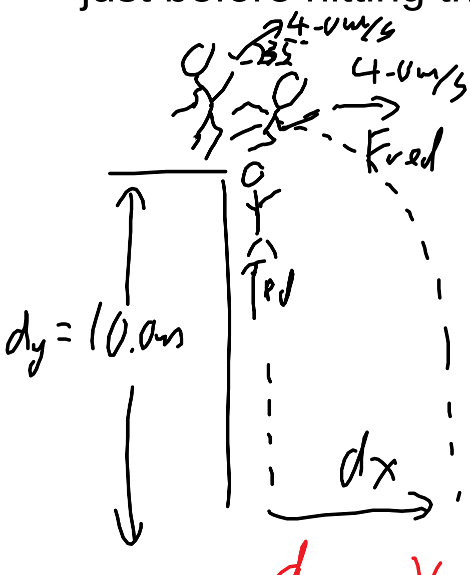


Big Idea:
Projectiles experience the acceleration due to gravity in the y direction and constant velocity motion in the x direction.

To solve problems - break the question into x and y components.

eg. Three friends go cliffdiving. Friend 1, Ted, steps off the cliff and falls straight down into the water.
Friend 2, Fred, runs at 4.00 m/s straight off the edge.
Friend 3, Ned, jumps just before the edge at 4.00 m/s up at 35.0 degree to the horizontal.
if the cliff is 10.0 m high,

a) How long does it take to hit the water?
b) where do they hit the water?
c) What is their velocity (magnitude and direction) just before hitting the water.





$$d_x = V_x t$$

$$V_{y_f} = V_{y_i} + gt$$

$$V_{y_f}^2 = V_{y_i}^2 + 2gd_y$$

Ted

$V_x = 0 \quad V_{y_i} = 0$

$a = g = 9.80 m/s^2$

$d_y = 10.0m$

a) $t = ?$ $d = \frac{1}{2}gt^2 + v_{y_i}t$ (→ 0)

$$t = \sqrt{\frac{2d}{g}} = \sqrt{\frac{2(10m)}{9.8 m/s^2}}$$

~~$t = 1.43s = 1.4s$~~

b) at the base of cliff

c) $V_{y_f} = at + v_i = 9.8(1.43) + 0$

$V_{y_f}^2 = V_{y_i}^2 + 2ad$

~~$V_{y_f} = 14 m/s$ down~~

14.0 m/s

Fred

a) Same as Ted

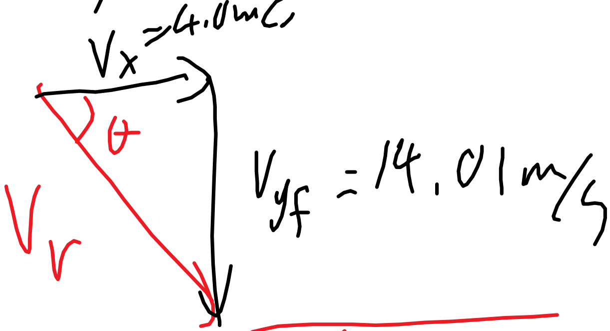
$t = 1.43s$

x-y are independent

b) $d_x = V_x t = (4.0 m/s)(1.43s)$

$= 5.7m$ ← from base of clif

c) $V_{yf}$ = same as Ted of cliff
but $V_x = 4.0 m/s$

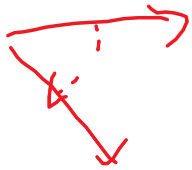



$V_r = \sqrt{V_{yf}^2 + V_x^2}$

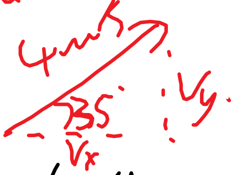
$V_r = \sqrt{14.01^2 + 4^2}$

$V_r = 14.6 m/s$

$\theta = \tan^{-1} \frac{14}{4} = 74°$ below horizontal



Ned




a) $V_{yi} = 4.0 m/s \sin 35.0°$
$= +2.2943 m/s$

$V_x = 4.0 m/s \cos 35.0°$
$= 3.277 m/s$

$a = g = -9.80 m/s^2$

$d_y = -10.0\,m$

a) $d_y = \frac{1}{2} g t^2 + v_{y_i} t$

$-10.0\,m = \frac{1}{2}(-9.8)t^2 + 2.294t$

$0 = -4.9t^2 + 2.294t + 10$

$$t = \frac{-2.294 \pm \sqrt{2.294^2 - 4(-4.9)(10)}}{2(-4.9)}$$

p62

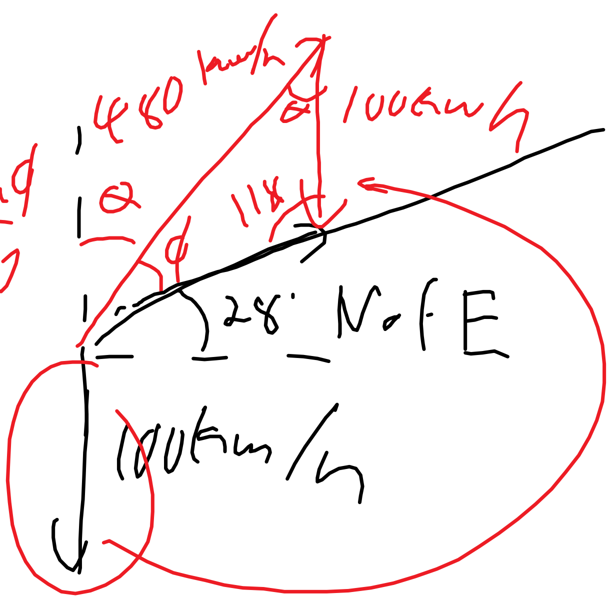
$\frac{10}{9} = 2.778\,m/s$ O

Block 2-4

Q30 p62

$\frac{\sin 118}{480} = \frac{\sin\phi}{100}$

$\theta = 180 - 118 - \phi$

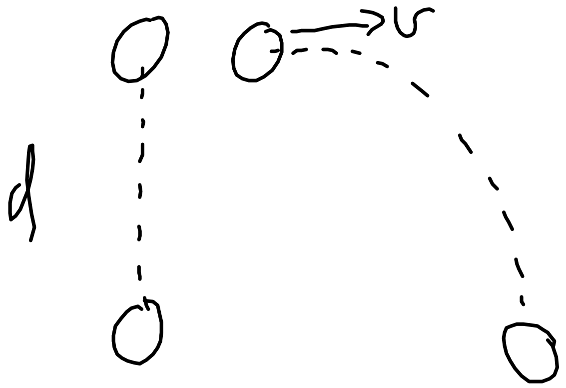


Projectiles
What's a projectile?
When you throw something.
Object moving through space under the influence of gravity without propulsion.

Assume air resistance is negligible (too small to matter) projectiles will accelerate down at g, 9.80m/$s^2$ near Earth.

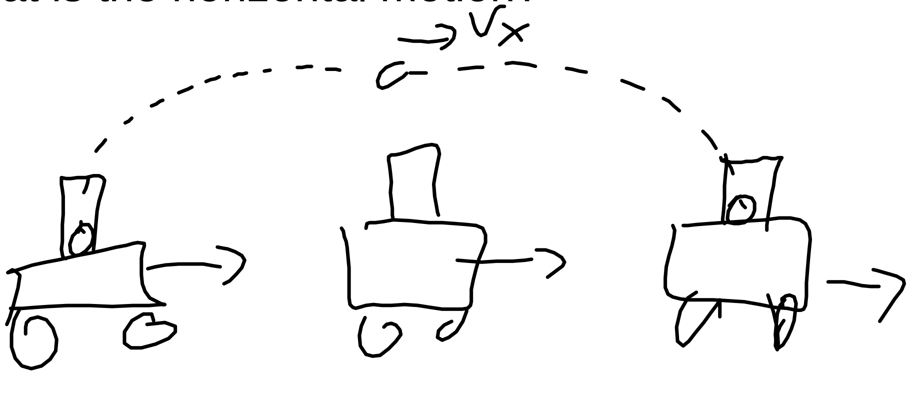
What if the projectile moves horizontally (x direction) and vertically (y direction)?

Look at two objects, one dropped, the other launched horizontally at the same time.




Both hit the ground at the same time.
What's the deal?
If air resistance is negligible, then the sideways motion doesn't influence the vertical motion.

The vertical motion is constant acceleration
ay = g
what is the horizontal motion?



$V_x$ of the ball is constant + same as car.

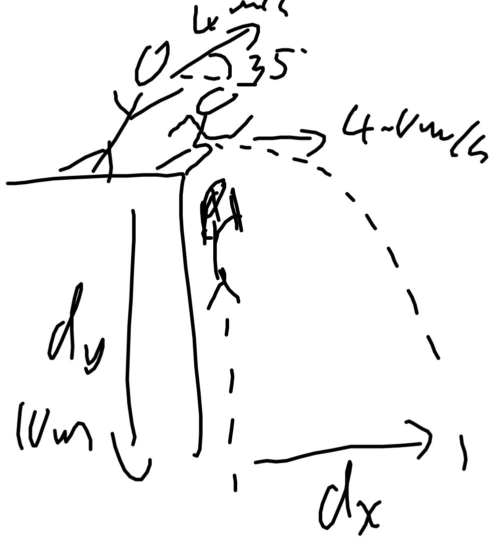
the horizontal velocity of a projectile is constant
$d_x = v_x t$

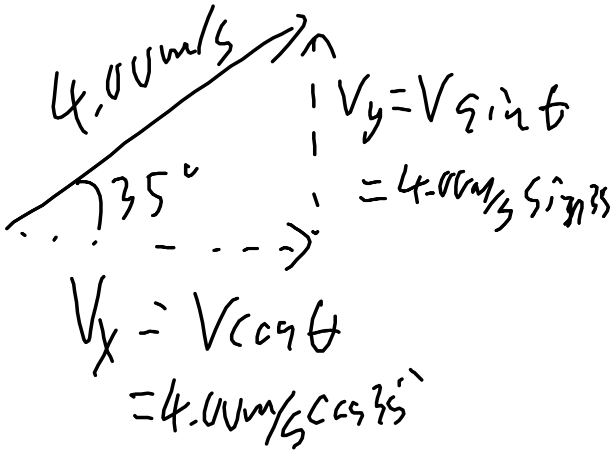
$d_y = v_{yi} t + 1/2\ g t^2$
$v_{yf} = v_{yi} + gt$
$v_{yf}^2 = v_{yi}^2 + 2gd_y$

Look at a sample question.

Three friends go cliffjumping.
Friend 1, Angela, steps off the cliff.
Friend 2, Edward, runs off the cliff at 4.00 m/s horizontally.
Friend 3, Mr. K. runs and jumps at the last minute, going at 4.00 m/s at 35.0 degrees above the horizontal.
If the cliff is 10.0m above the water,

a) how long does each friend take to hit the water?
b) where do they land?
c) what is their velocities just before hitting the water (magnitude and direction)?



Angela

$V_x = 0 \quad V_{y_i} = 0$

$a = g = 9.80 m/s^2$

$d_y = 10.0 m$

a) $t = ?$; $d = \frac{1}{2} g t^2 + V_{y_i} t$ (→ 0)

$t = \sqrt{\frac{2d}{g}} = \sqrt{\frac{2(10m)}{9.8 m/s^2}}$

$t = 1.43 s$ = ~~1.4 s~~

b) at the base of cliff

c) $V_y = at + V_i = 9.8(1.43) + 0$

$V_y^2 = V_{y_i}^2 + 2ad$

$V_{y_f} = 14 m/s$ down

Edward

a) Same as Angela

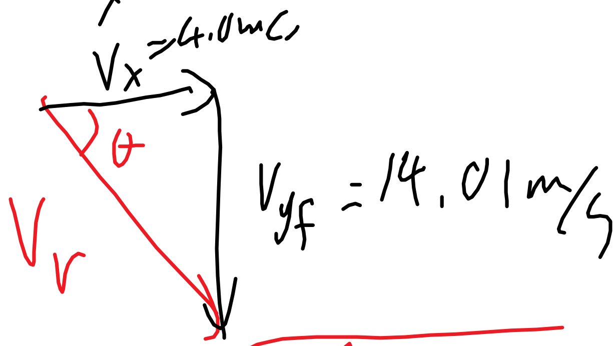
$t = 1.43 s$  x - y are independent

b) $d_x = V_x t = (4.0\,m/s)(1.43\,s)$

$= \boxed{5.7\,m}$ ← from base of clif

c) $V_{yf}$ = same as Angela

but $V_x = 4.0\,m/s$

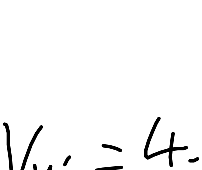



$V_r = \sqrt{V_{yf}^2 + V_x^2}$

$V_r = \sqrt{14.01^2 + 4^2}$

$V_r = \boxed{14.6\,m/s}$

$\theta = \tan^{-1}\frac{14}{4} = 74°$ below horizontal



Mr. K.

a) $V_{yi} = 4.0\,m/s \sin 35.0°$

$\pm(+)2.2943\ m/s$

$V_x = 4.0\ m/s \cos 35.0°$

$= 3.277\ m/s$

$a = g = (-)9.80\ m/s^2$

$d_y = (-)10.0\ m$

a) $d_y = \frac{1}{2} g t^2 + V_{y_i} t$

$-10.0\ m = \frac{1}{2}(-9.8)t^2 + 2.294t$

$0 = -4.9t^2 + 2.294t + 10$

$$t = \frac{-2.294 \pm \sqrt{2.294^2 - 4(-4.9)(10)}}{2(-4.9)}$$

p62 Q35-41odds, 47
45 for keeners